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INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Article 36 and Rule 70)



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| Applicant's or agent's file reference AA 1602 PCT | FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416) | |
| International application No. PCT/GB 03/03462 | International filing date (day/month/year) 08.08.2003 | Priority date (day/month/year) 09.08.2002 |
| International Patent Classification (IPC) or both national classification and IPC F01N3/023 | | |
| Applicant JOHNSON MATTHEY PUBLIC LIMITED COMPANY | | |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

 These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:
 - I ☒ Basis of the opinion
 - II ☐ Priority
 - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV ☐ Lack of unity of invention
 - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI ☐ Certain documents cited
 - VII ☐ Certain defects in the international application
 - VIII ☐ Certain observations on the international application

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| Date of submission of the demand 01.03.2004 | Date of completion of this report 22.11.2004 |
| Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016 | Authorized Officer Nobre, S Telephone No. +31 70 340-4635  |

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/GB 03/03462**

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-10 as published

Claims, Numbers

1-18 received on 19.10.2004 with letter of 19.10.2004

Drawings, Sheets

1/5-5/5 as published

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
☐ the language of publication of the international application (under Rule 48.3(b)).
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority in written form.
☐ furnished subsequently to this Authority in computer readable form.
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

**INTERNATIONAL PRELIMINARY
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International application No. **PCT/GB 03/03462**

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).
(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | |
|-------------------------------|-------------|------|
| Novelty (N) | Yes: Claims | 1-18 |
| | No: Claims | |
| Inventive step (IS) | Yes: Claims | 1-18 |
| | No: Claims | |
| Industrial applicability (IA) | Yes: Claims | 1-18 |
| | No: Claims | |

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Document WO 99 44 725 A (D1), which is considered to represent the most relevant state of the art, discloses (cf. pg. 1, line 6 to page 6, line 26, figs. 1 to 4):

An exhaust system (1) comprising a soot filter (4) packed with a mass of metal and a catalyst (2) located upstream of the filter (4) for oxidating NO to NO₂ for combusting soot collected on the filter (4), wherein the catalyst (2) is supported on a metal substrate having a lower packing density than the soot filter to permit the passage of soot particles.

An exhaust system comprising these features is also disclosed in document WO 01 96 717 A (D2).

From which the subject-matter of claim 1 differs in that the soot filter is packed with a mass of elongate, flat, narrow strip of metal and that the catalyst is supported on a metal substrate of the type used in the filter:

The objective to be achieved by the present invention may therefore be regarded as to produce a metal-based filter which can successfully compete with ceramic wall-flow filters in the commercial market. This objective is achieved by the above mentioned distinguishing features.

Although an exhaust system having a soot filter packed with a mass of elongate, flat, narrow strip of metal is disclosed in document US 4 270 936 A (D3), (cf. col. 2, line 3 to col. 4, line 28, figs. 1 to 4) or in document US 4 181 514 A (D4), (cf. col. 1, line 34 to col. 7, line 68, figs. 1 to 6) neither these documents or the documents cited in the international search report gives a reference, that would lead the skilled person to change the metal substrate of the filter and the catalyst disclosed in document D1 or D2 in order to arrive at an exhaust system according to claim 1.

Claim 1 is therefore considered as involving an inventive step (Article 33(3) PCT).

The subject-matter of dependent claims 2 to 18 is considered new and inventive, because these claims contain further embodiments of the exhaust system according to claim 1.

Hereby, claims 1 to 18 meet the requirements of article 33(1) PCT.

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CLAIMS:

1. An exhaust system for a lean-burn internal combustion engine comprising a soot filter packed with a mass of elongate flat, narrow strip metal and a catalyst located upstream of the filter for oxidising NO to NO₂ for combusting soot collected on the filter in NO₂, wherein the catalyst is supported on a metal substrate of the type used in the filter, but at a lower packing density, to permit passage of soot particles.
2. A system according to claim 1, comprising an exhaust gas treatment system comprising, in order from upstream to downstream, a plurality of metal-based filters adapted to successively trap smaller and smaller particles.
3. A system according to claim 2, comprising at least one wall flow filter for trapping yet smaller particles.
4. A system according to claim 2 or 3, comprising a flow-through monolith between the or each pair of metal-based filters.
5. A system according to claim 4, wherein the or each flow-through monolith comprises a NO oxidation catalyst, whereby to restore the NO₂ content, which had been decreased by reaction with soot in the preceding filter.
6. A system according to any preceding claim, wherein the filter capacity is sufficient to allow the soot to be combusted continuously by the oxidant.
7. A system according to any preceding claim wherein the filter capacity is sized for accumulations of soot sufficient to increase pressure-drop significantly before the next period of fast running and the system includes a bypass the pressure-drop through which is equal to the design maximum tolerated pressure-drop through the filter(s) whereby to avoid engine stalling.

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AA1602

8. A system according to claim 7, comprising means to limit soot emission to atmosphere, which means comprising a second stage such as a filter or impingement collector and/or an oxidation catalyst downstream of the bypass.
9. A system according to any preceding claim, wherein the filter has, wholly or domain-wise, a regular coiled, woven or knitted structure.
10. A system according to any preceding claim, wherein the metal of the filter is Type 300 or Type 400 stainless steel.
11. A system according to any preceding claim, wherein the metal of the filter comprises an iron alloy containing at least 11.5% Cr, 4% Al and 0.02-0.25% minor constituents such as rare earth, zirconium or hafnium.
12. A system according to any preceding claim, wherein the width of the metal strip of the filter is up to 2, especially in the range of 0.1 to 0.5 mm and its thickness is 0.2 to 0.8 of its width.
13. A system according to claim 8, wherein the flat, narrow strip metal is a flattened wire.
14. A system according to any preceding claim, wherein the filter packing carries a layer catalytic for soot oxidation.
15. A system according to claim 14, wherein the filter comprises a catalytic coating comprising a washcoat including Pt or oxides of Cs and V.
16. A system according to any preceding claim, comprising means for generating ozone and/or a plasma for combusting soot collected on the filter.
17. An internal combustion engine comprising an exhaust system according to any preceding claim.

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AA1602

18. A diesel engine according to claim 17.